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The National Earthquake Hazards Reduction Program (NEHRP): Issues in Brief

Peter Folger

Specialist in Energy and Natural Resources Policy

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Summary

Under the National Earthquake Hazards Reduction Program (NEHRP), four federal agencies have responsibility for long-term earthquake risk reduction: the U.S. Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute of Standards and Technology (NIST). These agencies assess U.S. earthquake hazards, deliver notifications of seismic events, develop measures to reduce earthquake hazards, and conduct research to help reduce overall U.S. vulnerability to earthquakes. Congressional oversight of the NEHRP program encompasses how well the four agencies coordinate their activities to address the earthquake hazard. Better coordination was a concern that led to changes to the program in legislation enacted in 2004 (P.L. 108-360).

P.L. 108-360 authorized appropriations for NEHRP through FY2009. Total funding enacted from reauthorization through FY2009 was \$613.2 million, approximately 68% of the total amount of \$902.4 million authorized by P.L. 108-360. Although authorization for appropriations expired in 2009, Congress has continued to appropriate funds for NEHRP activities. NEHRP agencies spent \$119.5 million for program activities in FY2013, less than FY2012 spending of \$124.1 million and less than the FY2014 enacted amount of \$121.4. Also, the American Recovery and Reinvestment Act (ARRA; P.L. 111-5) provided some additional funding for earthquake activities under NEHRP.

What effect funding at the levels enacted through FY2014 under NEHRP has had on the U.S. capability to detect earthquakes and minimize losses after an earthquake occurs is difficult to assess. The effectiveness of the NEHRP program is a perennial issue for Congress: it is inherently difficult to capture precisely, in terms of dollars saved or fatalities prevented, the effectiveness of mitigation measures taken before an earthquake occurs. A major earthquake in a populated urban area within the United States would cause damage, and in question is how much damage would be prevented by mitigation strategies underpinned by the NEHRP program.

Legislation introduced during the 113th Congress, Title 1 of H.R. 2132, would make changes to the program and would authorize appropriations totaling \$906 million over five years through FY2017 for NEHRP. Ninety percent of the funding would be designated for the USGS and NSF, and the remainder for FEMA and NIST. H.R. 2132 awaits further action in the House.

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Introduction

Portions of all 50 states and the District of Columbia are vulnerable to earthquake hazards, although risks vary greatly across the country and within individual states. Seismic hazards are greatest in the western United States, particularly in California, Washington, Oregon, and Alaska and Hawaii. Alaska is the most earthquake-prone state, experiencing a magnitude 7 earthquake almost every year and a magnitude 8 earthquake every 14 years on average. Because of its low population and infrastructure density, Alaska has a relatively low risk for large economic losses from an earthquake. In contrast, California has more citizens and infrastructure at risk than any other state because of the state's frequent seismic activity, large population, and extensive infrastructure.

The federal government has supported efforts to assess and monitor earthquake hazards and risk in the United States under the National Earthquake Hazards Reduction Program (NEHRP) since 1977. Four federal agencies responsible for long-term earthquake risk reduction coordinate their activities under NEHRP:

- U.S. Geological Survey (USGS);
- National Science Foundation (NSF);
- Federal Emergency Management Agency (FEMA); and
- National Institute of Standards and Technology (NIST).

Congress last made changes to NEHRP in 2004 (P.L. 108-360), and authorized appropriations through FY2009 for a total of \$902.4 million over five years. Legislation introduced in the 113th Congress (Title I of H.R. 2132) would make further changes to the program and would authorize total appropriations of \$906 million through FY2017.

Changes to NEHRP Since Its Inception

In 1977 Congress passed the Earthquake Hazards Reduction Act (P.L. 95-124) establishing NEHRP as a long-term earthquake risk reduction program for the United States. The program initially focused on research, led by USGS and NSF, toward understanding and ultimately predicting earthquakes. Earthquake prediction has proved intractable thus far, and the NEHRP program shifted its focus to minimizing losses from earthquakes after they occur. FEMA was created in 1979 and President Carter designated it as the lead agency for NEHRP. In 1980, Congress passed amendments to the Earthquake Hazards Reduction Act (P.L. 96-472), defining FEMA as the lead agency and authorizing additional funding for earthquake hazard preparedness and mitigation for FEMA and the National Bureau of Standards (now NIST).

A Shift in Program Emphasis to Hazard Reduction

Congress changed NEHRP's original focus on research to predict earthquakes in 1990 in P.L. 101-614. The law decreased the program's emphasis on earthquake prediction, clarified the role of FEMA, clarified and expanded the program objectives, and required federal agencies to adopt seismic safety standards for new and existing federal buildings. In 2004, Congress enacted P.L. 108-360 and adjusted the program again by shifting primary responsibility for planning and

coordinating NEHRP from FEMA to NIST. P.L. 108-360 also established a new interagency coordinating committee and a new advisory committee, both focused on earthquake hazards reduction.

The current program activities are focused on four broad areas:

1. developing effective measures to reduce earthquake hazards;
2. promoting the adoption of earthquake hazard reduction activities by federal, state, and local governments, national building standards and model building code organizations, engineers, architects, building owners, and others who play a role in planning and constructing buildings, bridges, structures, and critical infrastructure or “lifelines”;¹
3. improving the basic understanding of earthquakes and their effects on people and infrastructure through interdisciplinary research involving engineering, natural sciences, and social, economic, and decision sciences; and
4. developing and maintaining the Advanced National Seismic System (ANSS), the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES), and the Global Seismic Network (GSN).²

The House Science Committee report in the 108th Congress on H.R. 2608 (P.L. 108-360) noted that NEHRP has produced a wealth of useful information since 1977, but it also stated that the program’s potential has been limited by the inability of the NEHRP agencies to coordinate their efforts.³ The committee asserted that restructuring the program with NIST as the lead agency, directing funding towards appropriate priorities, and implementing it as a true interagency program would lead to improvement.

The 2004 law made the director of NIST chair of the Interagency Coordinating Committee. Other members of the committee include the directors of FEMA, USGS, NSF, the Office of Science and Technology Policy, and the Office of Management and Budget. The Interagency Coordinating Committee is charged with overseeing the planning, management, and coordination of the program. Primary responsibilities for the NEHRP agencies break down as follows (see also **Figure 1**):

- NIST is the lead NEHRP agency and has primary responsibility for NEHRP planning and coordination. NIST supports the development of performance-based seismic engineering tools and works with FEMA and other groups to promote the commercial application of the tools through building codes, standards, and construction practices.

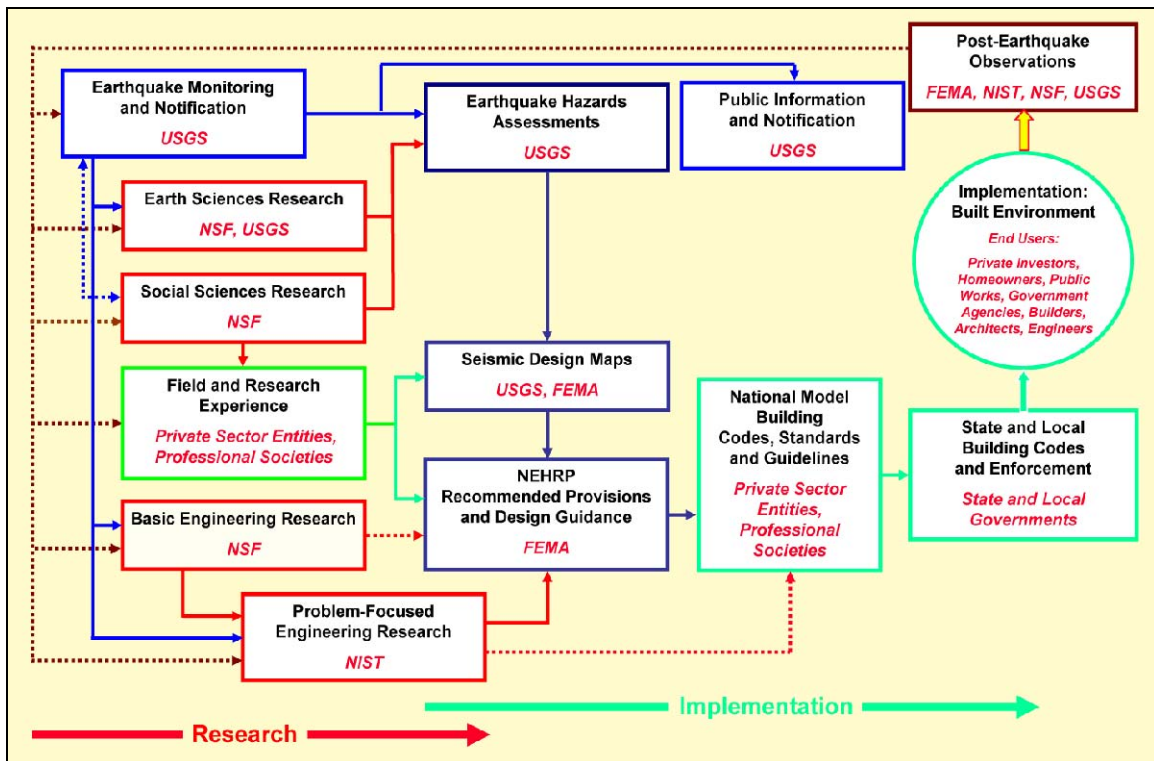
¹ Lifelines are essential utility and transportation systems.

² ANSS is a nationwide network of seismographic stations operated by the USGS. GSN is a global network of stations coordinated by the Incorporated Research Institutions for Seismology (IRIS, a nonprofit organization). NEES is an NSF-funded project that consists of 15 experimental facilities and an information technology infrastructure with a goal of mitigating earthquake damage by the use of improved materials, designs, construction techniques, and monitoring tools.

³ U.S. House of Representatives, Committee on Science, *National Earthquake Hazards Reduction Program Reauthorization Act of 2003*, H.Rept. 108-246 (Aug. 14, 2003), p. 13.

- FEMA assists other agencies and private-sector groups to prepare and disseminate building codes and practices for structures and “lifelines,” and aids development of performance-based codes for buildings and other structures.
- USGS conducts research and other activities to characterize and assess earthquake risks, and (1) operates a forum, using the National Earthquake Information Center (NEIC), for the international exchange of earthquake information; (2) works with other NEHRP agencies to coordinate activities with earthquake reduction efforts in other countries; and (3) maintains seismic hazard maps in support of building codes for structures and lifelines, and other maps needed for performance-based design approaches.
- NSF supports research to improve safety and performance of buildings, structures, and lifelines using the large-scale experimental and computational facilities of NEES and other institutions engaged in research and implementation of NEHRP.

Figure 1. NEHRP Agency Responsibilities and End Users of NEHRP Outcomes



Source: NEHRP program office at http://www.nehrp.gov/pdf/ppt_sdr.pdf (modified by CRS).

Table 1 shows the enacted budgets for NEHRP agencies from FY2005 through FY2014. The total enacted amount for FY2005-FY2009 was \$613.2 million, or 68% of the \$902.4 million total amount authorized in P.L. 108-360 over the five-year span (see **Table 2**). Authorization of appropriations for the program under P.L. 108-360 expired at the end of FY2009. Congress has continued to appropriate funds for NEHRP program activities.

Table I. Enacted Funding for NEHRP Since Enactment of P.L. 108-360 Through FY2012
(\$ millions)

		USGS	NSF	FEMA	NIST	Total
FY2005	Enacted	58.4	53.1	14.7	0.9	127.1
FY2006	Enacted	54.5	53.8	9.5	0.9	118.7
FY2007	Enacted	55.1	54.2	7.2	1.7	118.2
FY2008	Enacted	58.1	53.6	6.1	1.7	119.5
FY2009	Enacted	61.2	56.0	9.1	4.1	130.4
FY2010	Enacted	62.8	55.0	9.0	4.1	130.9
FY2011	Enacted	61.4	55.3	7.8	4.1	128.6
FY2012	Enacted	59.0	53.2	7.8	4.1	124.1
FY2013	Enacted	55.6	52.2	7.8	3.9	119.5
FY2014	Enacted	58.7	51.0	7.8	3.9	121.4

Source: NEHRP program office, 2005-2014 NEHRP Agency Budgets, via personal communication with Jack Hayes, Director, NEHRP, June 20, 2014.

Notes: According to the NEHRP program office, ARRA funds are not included. The USGS enacted funding reflects amount appropriated for the USGS; FEMA, NIST, and NSF budgets reflect agency allocations for NEHRP activities from the total agency appropriations.

NEHRP Legislation in the 113th Congress

Title I of H.R. 2132, the Natural Hazards Risk Reduction Act of 2013, would authorize appropriations for NEHRP through FY2017, retain NIST as the lead NEHRP agency, and authorize total appropriations of about \$906 million over five years. Title II of the bill would authorize appropriations for the National Windstorm Impact Reduction Act (first enacted in 2004 as Title II of P.L. 108-360 and modeled after NEHRP), and Title III would create an interagency coordinating committee, chaired by the director of NIST, that would oversee the planning and coordination of both the earthquake and wind hazards programs. The single interagency coordinating committee would replace the two separate interagency committees overseeing the current earthquake and wind hazards programs. The bill was introduced on May 23, 2013, by Representative Frederica Wilson, and referred to the House Committee on Science, Space, and Technology, the Committee on Natural Resources, and the Committee on Transportation and Infrastructure.

The bill would give the interagency coordinating committee authority to “make proposals for planning and coordination of any other Federal research for natural hazard mitigation that the Committee considers appropriate.” The potentially broader mandate for the interagency coordinating committee—to embrace all natural hazards in its deliberations—could reflect an emphasis on natural hazard *mitigation* presented in the bill’s “Findings” section. The bill finds that research is needed to better understand institutional, social, behavioral, and economic factors that influence how risk mitigation is implemented, and that a major goal of federally supported natural hazards-related research should be to increase the adoption of hazard mitigation measures.

The House has not acted on H.R. 2132; however, on July 29, 2014, the House Science, Space, and Technology Committee, Subcommittee on Research and Technology, held a hearing that

reviewed the NEHRP program. According to the charter, the hearing intended to examine strengths, weaknesses, challenges, and accomplishments of NEHRP.⁴

Authorization of Appropriations in H.R. 2132

H.R. 2132 would authorize total appropriations for NEHRP of approximately \$906 million for a five-year period ending in FY2017, with 90% of the funding authorized for the USGS and NSF, and the remainder for FEMA and NIST. (See **Table 2**.) The total authorized amounts would be slightly greater than what was authorized by P.L. 108-360 over five years from FY2005 through FY2009.

Table 2. NEHRP Authorization for Appropriations Under H.R. 2132 (113th Congress)
(\$ millions)

	FY2013	FY2014	FY2015	FY2016	FY2017	Total FY2013-FY2017	Total FY2005-FY2009
USGS	90.0	92.1	94.3	96.5	98.8	471.7	423.6
NSF	64.1	66.1	68.0	70.1	72.2	340.5	306.3
FEMA	10.2	10.6	10.9	11.2	11.5	54.4	111.5
NIST	7.0	7.7	7.9	8.2	8.4	39.2	61.0
Total	171.3	176.5	181.1	186.0	190.9	905.8	902.4

Source: U.S. House of Representatives, H.R. 2132; and P.L. 108-360.

Note: Total authorization for appropriations for FY2005-FY2009 from P.L. 108-360. Totals may not sum due to rounding.

The USGS would receive the largest share—about 52%—of total authorized appropriations under H.R. 2132 as under the expired authorization of appropriations for NEHRP, and the total amount authorized for the USGS would be approximately \$48 million more than the amount authorized for FY2005 through FY2009. As with the previous authorization, H.R. 2132 singles out the Advanced National Seismic System (ANSS) to receive a subset of authorized appropriations within the total USGS-authorized amount. Specifically, ANSS would be authorized to receive \$36 million in FY2013, \$37 million in FY2014, \$38 million in FY2015, \$39 million in FY2016, and \$40 million in FY2017. That would total \$190 million over five years, compared to a total of \$174 million over five years in the previous authorization.

NEHRP and Induced Seismicity

The Advisory Committee on Earthquake Hazards Reduction, created by P.L. 108-360, made several recommendations to the NEHRP program in its March 15, 2013, report to the Director of NIST and to the Interagency Coordinating Committee.⁵ One of the recommendations called for increased seismic monitoring to respond to the increased oil and gas exploration and production

⁴ The hearing charter is available at <http://science.house.gov/sites/republicans.science.house.gov/files/documents/7%2029%2014%20NEHRP%20Hearing%20Charter.pdf>.

⁵ Advisory Committee on Earthquake Hazards Reduction, National Earthquake Hazards Reduction Program, letter to Patrick D. Gallagher, Director, National Institute of Standards and Technology, March 15, 2013, <http://www.nehrp.gov/pdf/2013ACEHRReportFinal.pdf>.

in the central and eastern United States. Accompanying the increased oil and gas activity has been an increase in deep well injection and disposal of oilfield brines, produced water, and flowback water from hydraulic fracturing activities. There are reports that in some instances the deep well injection activities may have triggered earthquakes, some damaging, in regions that are not identified as particularly seismically active on U.S. earthquake hazard maps.⁶ In Oklahoma, for example, the rate of earthquakes has increased by about 50% since October 2013, and the USGS has postulated that a likely contributing factor to the increased seismicity has been wastewater injected into deep geologic formations.⁷

Outlook and Issues for Congress

At present earthquakes can be neither accurately predicted nor prevented, and in its 1990 reauthorization NEHRP shifted its program emphasis from prediction to hazard reduction. The program's focus has been on understanding the earthquake hazard and its risk to populations and infrastructure in the United States, developing effective measures to reduce earthquake hazards, and promoting the adoption of earthquake hazards reduction measures in vulnerable areas.

Legislation to modify NEHRP in the 108th Congress (P.L. 108-360) reflected congressional concerns about how well the four NEHRP agencies coordinated their efforts to maximize the program's potential. As part of its oversight responsibilities, Congress may consider evaluating how effectively the agencies have responded to Congress's direction in P.L. 108-360 to improve coordination since 2004.

In the 113th Congress, legislation introduced to make changes to NEHRP—Title 1 of H.R. 2132—states that a major goal for the program should be “to reduce the loss of life and damage to communities and infrastructure through increasing the adoption of hazard mitigation measures.” The bill further emphasizes the social aspects of mitigating earthquake hazards, calling for research to better understand institutional, social, behavioral, and economic factors that influence how risk mitigation is implemented, in addition to the traditional research into understanding how, why, and where earthquakes occur.

Both the House and the Senate introduced legislation to authorize NEHRP and make changes to the program in the 112th Congress, and two bills were reported out of committee and placed on the legislative calendar in both chambers (H.R. 3479 and S. 646). Among other changes, H.R. 3479 would have authorized appropriations for three years instead of five. The Senate bill, S. 646, would have authorized appropriations for five years. Neither bill received further action in the 112th Congress.

The emphasis on mitigation proposed by H.R. 2132 reflects at least two fundamental challenges to increasing the nation's resiliency to earthquakes, and to most other major natural hazards such as hurricanes and major floods. The first is to assess whether social, behavioral, and economic factors can be understood in sufficient degree to devise strategies that influence behavior to

⁶ See, for example, National Research Council, “Induced Seismicity Potential in Energy Technologies,” Board on Earth Sciences and Resources, 2012, http://www.nap.edu/catalog.php?record_id=13355.

⁷ U.S. Geological Survey-Oklahoma Geological Survey, *Record Number of Oklahoma Tremors Raises Possibility of Damaging Earthquakes*, Joint Statement on Oklahoma Earthquakes, May 2, 2014, http://earthquake.usgs.gov/regional/ceus/products/newsrelease_05022014.php.

mitigate risk posed by the hazard. Put simply, what motivates people and communities to adopt risk mitigation measures that address the potential hazard? A second challenge is how to measure the effectiveness of NEHRP more quantitatively. It is inherently difficult to capture precisely, in terms of dollars saved or fatalities prevented, the effectiveness of mitigation measures taken before an earthquake occurs. A major earthquake in a populated urban area within the United States would cause damage, and in question is how much damage would be prevented by mitigation strategies underpinned by the NEHRP program.

The history of the NEHRP program has evolved with the recognition that it is unlikely to provide information that would allow earthquake prediction. The program has shifted its emphasis towards reducing losses during an earthquake. Establishing a precise relationship between NEHRP activities and reduced losses from an actual earthquake may also be difficult. However, as more accurate seismic hazard maps evolve, as understanding of the relationship between ground motion and building safety improves, and as new tools for issuing warnings and alerts are devised, trends denoting the effectiveness of NEHRP activities may emerge more clearly.

Author Contact Information

Peter Folger
Specialist in Energy and Natural Resources Policy
pfolger@crs.loc.gov, 7-1517